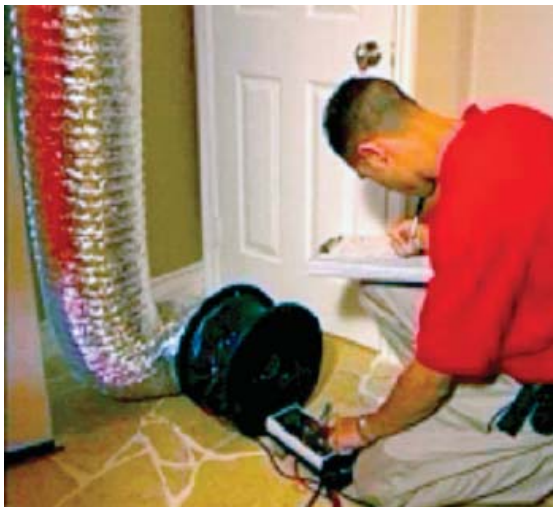
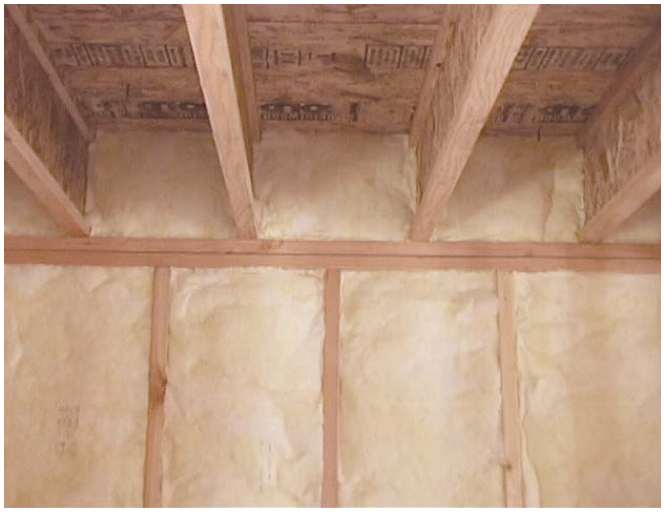
2005 BUILDING ENERGY EFFICIENCY STANDARDS

CALIFORNIA ENERGY COMMISSION





RESIDENTIAL COMPLIANCE MANUAL

COMMISSION CERTIFIED MANUAL

CEC-400-2005-005-CMF

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3Q-05

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List of Tables

1.6 Mandatory Measures and Compliance Approaches

In addition to the mandatory measures (Section 1.1.6), the Standards provide two basic methods for complying with low-rise residential energy budgets: the prescriptive approach and the performance approach. The mandatory measures must be installed with either of these but note that mandatory measures may be superseded by more stringent measures under the prescriptive approach.

1. The prescriptive approach (composed of several prescriptive packages) (Section 1.6.2) is the simpler. Each individual energy component of the proposed building must meet a prescribed minimum efficiency. The prescriptive approach offers relatively little design flexibility but is easy to use. There is some flexibility for building envelope components, such as walls, where portions of the wall that do not meet the prescriptive insulation requirement may still comply as long as they are area-weighted with the rest of the walls, and the average wall performance complies.
2. The performance approach (Section 1.6.3) is more complicated but offers considerable design flexibility. The performance approach requires an approved computer software program that models a proposed building, determines its allowed energy budget, calculates its energy use, and determines when it complies with the budget. Compliance options such as window orientation, shading, thermal mass, zonal control, and house configuration are all considered in the performance approach. This approach is popular with production home builders because of the flexibility and because it provides a way to find the most cost-effective solution for complying with the Standards.

For additions and alterations, see Chapter 8 for details of compliance approaches that are available.

1.6.1 Mandatory Measures

With either the prescriptive or performance compliance paths, there are mandatory measures that must always be installed. Many of the mandatory measures deal with infiltration control and lighting; others require minimum insulation levels and equipment efficiency. The minimum mandatory levels are sometimes superseded by more stringent prescriptive requirements. For example, if mandatory measures specify R-19 ceiling insulation and the prescriptive approach, Package D, is used, R-30 or R-38 ceiling insulation (depending on climate zone) must be installed. Conversely, the mandatory measures may be of a higher efficiency than permitted under the performance approach; in these instances, the higher mandatory levels must be installed. For example, a building may comply the performance computer modeling with only R-7 insulation in a raised floor, but R-13 must be installed because that is the mandatory minimum in prescriptive Package D.

The third and final inspection comes at the end after the walls have been closed and the final electrical and plumbing fixtures are in place. In the typical building inspection process, it is difficult to verify that energy efficiency is being achieved at this point. For instance, the insulation is not in place at the time of the framing inspection and is concealed at the time of the final inspection. For this and other reasons, the Installation Certificate and or field verification and/or diagnostic testing is critical. The Installation Certificate certifies the R-value of insulation installed in the roof, ceiling, walls, floor, slab and foundation walls, including the brand, thermal resistance (R-value), and the thickness.

2.2.7 Field Verification and/or Diagnostic Testing

Some building features require field verification and/or diagnostic testing by a third party inspector. The Energy Commission has a process for certifying HERS raters, and a certified HERS rater is required when field verification and/or diagnostic testing is necessary.

Both prescriptive packages C and D as well as most performance method applications require some sort of field verification and/or diagnostic testing. Some of the typical measures that require field verification and/or diagnostic testing are split system air conditioners, thermostatic expansion valve (TXV) and duct sealing. Other measures requiring verification include refrigerant charge, reduced duct surface area, increased duct R-value, and high EER cooling equipment. Other measures that require diagnostic testing are reduced infiltration through blower door testing and reduced fan power. Quality installation of insulation is another measure that requires field verification and/or diagnostic testing.

The requirements for field verification and/or diagnostic testing apply only when equipment or systems are installed that require verification or testing. If a house has no air distribution ducts, then a HERS rater does not have to test the ducts, since there are no ducts to test. Similarly, if a house showing prescriptive compliance does not have a split system air conditioner or heat pump, then a HERS rater does not have to test the refrigerant charge or verify that there is a TXV, because the requirements do not apply. Likewise, if compliance for a house is achieved using an alternative that does not require a TXV, then a HERS rater does not have to come to the site and verify that one has been installed.

Some homes along the coast are built without air conditioning and use hydronic systems or other heating systems without air distribution ducts. In this case, a HERS rater is not required, even when prescriptive package D or C is used for compliance, unless compliance credit is desired for measures such as quality insulation installation (see Residential ACM Appendix RH).

2.2.8 Approval for Occupancy

In multifamily dwellings of three and more units, the final step in the compliance and enforcement process is when the building department issues an occupancy permit. This is the green light for occupants to move in. Single family dwellings and duplexes may be approved for occupancy without an occupancy permit

When the designer is a licensed professional, the signature block must include the license number.

2.4.2 Documentation Author

The documentation author is the person responsible for completing the compliance documentation at the building permit phase that demonstrates that a building complies with the standards.

The documentation author is not subject to the limitations and restrictions of the *Business and Professions Code*. The documentation author's signature is to verify that the documentation is accurate and complete.

For a list of qualified documentation authors visit Commissions website at www.energy.ca.gov/efficiency/cabec_roster.html

2.4.3 Builder or General Contractor

The builder means the general contractor responsible for construction. For production homes, the builder may also be the developer with responsibility for arranging financing, acquiring the land, subdividing the property, securing the necessary land planning approvals and attending to the other necessary tasks that are required prior to actual construction. Many production builders are also involved in the marketing and sales of homes after they are constructed.

During the construction process, the builder or general contractor usually hires specialty contractors to provide specific services, such as installing insulation, designing and installing HVAC systems, etc. For homes that do not require a design professional, the builder may sign the Certificate of Compliance (CF-1R) in the "Designer or Owner" signature block.

The builder may also sign the Installation Certificate (CF-6R) on behalf of the specialty contractors it hires, but normally completion and signature responsibility rests with the specialty contractor.

The contractor shall also cooperate with the HERS rater if field verification and/or diagnostic testing is required. One of the tasks is to provide the HERS provider a copy of the CF-6R signed by the appropriate builder employees or sub-contractors. This document will identify the measures that require field verification and/or diagnostic testing. Ultimately it is the builder's responsibility to ensure that the CF-6R is provided to the HERS rater (RACM Manual, chapter 7).

2.4.4 Specialty Contractors

Specialty contractors include the firms that install insulation, install windows, install HVAC systems and/or duct systems, install water heating and plumbing systems and perform other specialist type services during building construction. Though the builder has ultimate responsibility and may complete all the sections of the CF-6R, specialty contractors may, and are encouraged to, be responsible

Fenestration

Package D requirements for glazing area were modified. Prior to 2005, the maximum glazing area that was permitted depended on climate zone. Along the coast, fenestration area was limited to 20% of the conditioned floor area (CFA), where in other California climate zones the limit was 16% of the CFA.

With the 2005 update, the Standards were changed to have a consistent fenestration area of 20% of the CFA in all California climate zones and west-facing glass to a maximum of 5% of the floor area in climate zones 2, 4, and 7-15. West-facing fenestration area includes skylights tilted to the west or tilted in any direction when the pitch is less than 1:12. See §151(f) 3 C and in Section 3.2.3 of this chapter.

With the 2005 Standards, there is no longer a credit for reducing window area below the prescriptive limit of 20%. This approach is similar to the Standards for nonresidential buildings that have been in force since 1992. This change does not mean that the Energy Commission believes that reducing fenestration area will not save energy, but that window area is really more of an amenity, like floor area itself, and should not be treated as a conservation measure.

One of the significant impacts of making fenestration area neutral is that the standards become significantly more stringent for multifamily buildings and for other low-rise buildings that typically have small glass area. Multifamily buildings typically have fenestration areas in the range of 12% to 15% of the floor area. Prior to the 2005 update, when the performance method was used, a considerable credit was available based on the difference between the fenestration area in the building and the fenestration area allowed by the 2001 standards (either 16% or 20%). This credit allowed trade-offs and therefore resulted in lesser energy efficiency features installed in buildings.

The U-factors (default and required) of fenestration products were modified with the 2005 update, but these changes do not represent a change in stringency. The National Fenestration Rating Council (NFRC) rating procedure for windows was changed, resulting in the same window having a slightly lower U-factor. This change brings the requirements in line with the test results. A window that complied with the 2001 standards will still comply with the 2005 standards; both the criteria and the rated value are slightly lower.

Insulation Installation Quality

Another significant change with the 2005 update is that credit is offered for improving the quality of insulation installation. This credit, which is available only with the performance approach, requires third-party verification. The quality of the installation has a significant impact on thermal performance. Three problems can be created by improper installation: when insulation is not in contact with the air barrier(s), an air space can be created that in effect “short circuits” the effectiveness of the insulation; gaps or voids in the insulation can lead to significant portions of the wall, roof or floor being essentially not insulated; and compression of the insulation, usually around pipes or other building services

be certified not to be less than the values listed below. Note that the minimum efficiency for this equipment changes on January 23, 2006.

Table 4-4 – Minimum Cooling Efficiencies for Central Air Conditioners and Heat Pumps
Source: California Appliance Efficiency Regulations

Appliance	Type	SEER	
		Prior to 1/23/06	On and After 1/23/06
Central Air Conditioners	Split System	10.0	13.0
	Single Package	9.7	13.0
Central Air Source Heat Pumps	Split System	10.0	13.0
	Single Package	9.7	13.0

Other Air Conditioners and Heat Pumps

Appliance Efficiency Regulations

The current Appliance Efficiency Regulations for larger central air conditioners and heat pumps, and for all room air conditioners and room air conditioner heat pumps shall be certified by the manufacturer to not to be less than the values listed in Table 4-5 and 4-6.

Table 4-5 – Minimum Cooling Efficiency for Larger Central Air Conditioners and Heat Pumps
Source: California Appliance Efficiency Regulations

Equipment Type	Size Category	EER
Central Air Conditioners	65,000 Btu/h up to 135,000 Btu/h	8.9
Central Air Source Heat Pumps	65,000 Btu/h up to 135,000 Btu/h	8.9
Central Water Source Heat Pumps	Up to 135,000 Btu/h	12.0

The standards recognize other distribution systems that may be more or less efficient than the standard system. Table 5-1 gives brief definitions of all of the distribution system types for water heating serving a single dwelling that are recognized by the standards.

Table 5-1 – System Component Descriptions: Distribution Systems within a Dwelling Unit

Distribution Systems	Description
Standard (STD)	Standard system without any pumps for distributing hot water. The first 5 ft of pipes from the storage tank is insulated for both hot and cold water pipes. Pipes from the water heater to the kitchen that are 0.75 in. or larger are insulated. Pipe insulation is required per §150(j).
Point of Use (POU)	System with no more than 8 ft horizontal distance between the water heater and hot water fixtures, except laundry.
Pipe Insulation (PIA)	All hot water pipes are insulated per the requirements of §150(j).
Standard Pipes with No Insulation (SNI)	Standard system, but without insulation on the pipes to the kitchen.
Parallel Piping (PP)	Individual pipes radiate from a manifold on the water heater to each of the fixtures.
Recirculation No Control (RNC)	Distribution system using a pump to recirculate hot water to branch piping though a looped hot water main. Pump operation and water flow are continuous. Pipe insulation is required per §150(j).
Recirculation with Temperature Control (RTmp)	Recirculation system that uses temperature controls to cycle pump operation to maintain recirculated water temperatures within certain limits. Pipe insulation is required per §150(j).
Recirculation with Timer Control (RTm)	Recirculation system that uses a timer control to cycle pump operation based on time of day. Pipe insulation is required per §150(j).
Recirculation with Timer and Temperature Control (RTmTmp)	Recirculation system that uses both temperature and timer controls to regulate pump operation. Pipe insulation is required per §150(j).
Recirculation with Demand Control (RDmd)	Recirculation system that uses brief pump operation to recirculate hot water to fixtures just prior to hot water use when a demand for hot water is indicated. Pipe insulation is required per §150(j).

For water heating systems that serve multiple dwellings, there are separate distribution system definitions and requirements. The terms “Standard,” “Point of Use,” “Standard Pipes with No Insulation” and “Parallel Piping” do not apply to systems serving multiple dwellings. The term “Pipe Insulation” has a different meaning for central water heating systems than for systems serving a single dwelling unit. Piping for recirculation loops is required by the mandatory measures to be insulated, but a higher level of insulation can also save energy and is recognized by the compliance software programs.

Additionally, more information is required for demonstrating compliance of systems serving multiple dwelling units. The compliance documentation must specify the length of piping that is inside the building, outside, or underground, and the insulation R-value on each portion

The base case system used to develop the standard budget for central water heating assumes a minimal amount of piping outside and none underground. It also assumes a recirculation pump with a timer control, and R-4 or R-6 insulation on the pipes (depending upon pipe diameter). The new proposed system also is assumed to have a recirculation pump, but in an existing multiple dwelling building it may lack controls. There is an exception for multifamily

buildings of six units or less using the performance approach when no recirculation pump is installed. However, the distribution system in the Standard Design and Proposed design will both assume a pump with timer controls. See §113(c) 2 and §151(f) 8 C

5.2 Mandatory Requirements

5.2.1 Equipment Certification

§113(a)

Water heaters must be certified by manufacturers as complying with the *Appliance Efficiency Regulations* at the time of manufacture. Regulated equipment may not be sold in California unless it is certified. This includes the following types of water heaters:

- Gas water heaters and boilers
- Heat pump water heaters
- Electric water heaters and boilers
- Oil-fired water heaters and boilers.

5.2.2 Equipment Efficiency

§113(b), §111

Small water heaters are regulated by the federal standards. The efficiency requirements for such equipment are given in Table 5-2 below. The efficiency rating for small water heaters is called the energy factor (EF). The EF is intended to represent the overall efficiency of a water heater, combining the recovery efficiency and standby losses. The Energy Factor for water heaters other than heat pump water heaters is a number that varies between zero and less than one, and is based on standard test conditions designed to represent a typical 24-hour period. During the test, 64.3 gallons of hot water is withdrawn in six equal draws at one hour intervals and then the water heater sits idle for the remaining 24 hour period. Set point temperatures and inlet temperatures are standardized for the test.

If the Total Percentage of Fenestration exceeds 20%, performance compliance approach must be used. Likewise if the total west facing fenestration area in climate zones 2, 4, and 7-15, exceeds 5% of the CFA, the performance compliance approach must be used.

- If the addition has a floor area of 100 ft² or less, then up to 50 ft² of fenestration area is allowed, additions that add less than 50ft^2 of fenestration area need to meet the Package D requirements for fenestration U-factor and SHGC, but are exempt from the fenestration maximum total area limits (this includes both 20% of conditioned floor limit and the 5% west facing limit). There is no credit for glazing removed when using this option. For additions with floor areas of 100 ft² or less that have greater than 50 ft^2 of fenestration area, the performance compliance is optional or use the less than 1,000 ft² approach.
- If the addition has a floor area equal to or less than 1,000 ft², then only R-13 wall insulation is required in all climate zones and shall meet all the requirements of Package D as indicated in Table 8-2. The allowed 20% glazing, of which a maximum 5% is allowed as west facing glazing (in climate zones 2, 4, and 7-15) may be increased by the amount of glazing removed in the wall that separates the addition from the existing house.
- If the addition has a floor area greater than 1,000 ft² the fenestration need to meet the Package D requirements for fenestration U-factor and SHGC, and the fenestration maximum total area limits, this includes both 20% of conditioned floor limit and the 5% west facing limit in climate zones 2, 4, and 7-15.

Table 8-2 – Prescriptive Envelope Requirements for Additions

	Size of Addition		
Component	100 ft² or less	1,000 ft² or less	More than 1,000 ft²
Ceiling Insulation	R-19	Package D	Package D
Wall Insulation [1]	R-13	R-13	Package D
Floor Insulation	R-13	Package D	Package D
Fenestration U- factor [3]	Package D	Package D	Package D
Glazing Area	≤ 50 ft²	Package D (20%) + Glass Removed	Package D
Solar Heat Gain Coefficient (SHGC)	Package D	Package D	Package D
Radiant Barrier [2]	Package D	Package D	Package D

[1] *Heavy mass and light mass walls may meet the Package D requirements for mass wall insulation instead of R-13.*
[2] *The radiant barrier requirement applies only to the roof area of the addition. It is not necessary to retrofit a radiant barrier in the existing attic.*
[3] *Dual-glazed greenhouse windows and dual-glazed skylights are assumed to meet the applicable U-factor requirement.*

The Package D Alternative, which requires more energy efficient windows and space conditioning equipment in lieu of measures that require field verification and diagnostic testing, may also be used with addition alone, provided that if space conditioning equipment is installed, it will have the specified efficiency,

Since the addition is smaller than 100 ft^2, the fenestration area is limited to a maximum of 50 ft^2. The fenestration must meet the U-factor and SHGC requirements of Package D. For climate zone 7, these fenestration requirements are a maximum U-factor of 0.67 and a maximum SHGC of 0.40. For an addition of this size, insulation only must meet the mandatory requirements of R-19 ceiling insulation; R-13 wall insulation and R-13 floor insulation.

Since the existing heating and cooling equipment is being used for the addition, that equipment does not have to meet the mandatory equipment efficiency requirements. Mandatory duct insulation requirements of §150(m) apply (R 4-2 minimum in unconditioned space). All other mandatory requirements in §150 must be met. Note that this addition could comply with the requirements of §152 (a) 1 B, instead. For some additions this could allow more glazing area but additional Package D measures would apply.

Example 8-5

Question

A kitchen is being expanded by 150 ft^2. As part of the addition a sliding glass door (42 ft^2) is being removed. How much fenestration area is allowed for this addition?

Answer

Since this addition is no larger than 1000 ft^2, the Standard permits the area of fenestration removed during the remodel to be added to the Package D fenestration area allowance (20% of floor area). In this case, the Package D allowance is 30 ft^2. Therefore, the total allowance for this addition is 72 ft^2 of fenestration area. If the addition were larger than 1000 ft^2, the area of the fenestration removed could not be added to the 20% Package D fenestration area allowance.

Example 8-6

Question

If I remove a window from the existing house while doing an addition, can I re-use this window in the addition, or does it need to meet a certain U-factor criterion?

Answer

You can use this existing window in the addition; however, you must use the actual or default U-factor and SHGC of this window in showing compliance. Therefore, meeting the prescriptive requirements may not be possible, and performance compliance may be the only option. Window certification and labeling requirements of §116(a) do not apply to used windows.

Example 8-7

Question

For additions and alterations that include a greenhouse window or a skylight, what are the U-factor and SHGC requirements? What is the area used for calculations for greenhouse windows?

Answer

In additions and alterations, you can assume that double-glazed greenhouse windows or skylights have the U-factor required to comply with the prescriptive standards and that this U-factor can also be used to determine compliance with performance approaches. Alternatively, the NFRC rated U-factor may be used if it meets the U-factor required in the prescriptive package. However, for greenhouse windows or skylights the SHGC must meet the

Project Title	*Date*

SPECIAL FEATURES NOT REQUIRING HERS VERIFICATION (add extra sheets if necessary)

Indicate which special features are part of this project. The list below represents special features relevant to the Prescriptive and Performance Method.

✓	Feature	Required Forms (if applicable)	Description
☐	Metal Framed Walls	CF-1R	
☐	Radiant Barriers	CF-1R	
☐	Exterior Shades	WS	
☐	Cool Roof	N/A; Performance Calculation Required. Attach CRRC Label to Forms.	
☐	Dedicated Hydronic Heating System	Performance Calculation Required; Attach Run to Forms.	
☐	Combined Hydronic System	Performance Calculation Required; Attach Run to Forms.	
☐	Gas Cooling	N/A; Performance Calculation Required.	
☐	Buried Ducts	N/A; Indicate on building plans.	
☐	Kitchen Pipe Insulation	See Section 5.6.2 Distribution Systems in Residential Manual.	
☐	Multiple Water Heaters Per Dwelling Unit	See Table 5-13 or use Performance Calculation and attach Run to Forms.	
☐	Central Water Heating System Serving Multiple Dwellings	Performance Calculation and attach Run to Forms.	
☐	Non-NAECA Large Water Heater	CF-1R	
☐	Indirect Water Heater	See Table 5-13 or use Performance Calculation and attach Run to Forms	
☐	Instantaneous Gas Water Heater	See Table 5-13 or use Performance Calculation and attach Run to Forms	
☐	Solar Water Heating System	See Table 5-13 or use Performance Calculation and attach Run to Forms	
☐	Wood Stove Boiler	Performance Calculation and attach Run to Forms	

SPECIAL FEATURES REQUIRING HERS RATER VERIFICATION

(add extra sheets if necessary) Indicate to the HERS Rater which credits are part of this project and need verification.

✓	Feature	Required Forms (if applicable)	Description
☐	Duct Sealing	CF-6R part 4 of 12	
☐	Refrigerant Charge	CF-6R part 5 of 12	
☐	Thermostatic Expansion Valve	CF-6R part 6 of 12	

Site Address	Permit Number

Installation certificates (CF-6R) are required for each and every dwelling unit. When the installation of measures that require field verification and diagnostic testing is complete, the builder or the builder's subcontractor shall complete diagnostic testing and the procedures specified in this section. When the installation is complete, the builder or the builder's subcontractor shall complete the CF-6R (Installation Certificate), and keep it at the building site for review by the building department. The builder also shall provide a copy of the Installation Certificate to the HERS rater for any measures requiring field verification and diagnostic testing, per Section 10-103(a).

WATER HEATING SYSTEMS:

Heater Type	CEC Certified Mfr Name & Model Number	Distribution Type (Std, Point-of-Use, etc)	If Recirculation, Control Type	# of Identical Systems	Rated Input (kW or Btu/hr)[1]	Tank Volume (gallons)	Efficiency (EF, RE)[2]	Standby Loss (%)[2]	External Insulation R-value[2]

1 For **small gas storage** (rated input of less than or equal to 75,000 Btu/hr), **electric resistance** and **heat pump water heaters**, list Energy Factor (EF). For **large gas storage water heaters** (rated input of greater than 75,000 Btu/hr), list Recovery (RE), Thermal Efficiency, Standby Loss and Rated Input. For **instantaneous gas water heaters**, list Thermal Efficiency and Rated Input.

2. R-12 external insulation is mandatory for storage water heaters with an energy factor of less than 0.58.

Kitchen Piping:
If indicated on the CF-1R, all hot water piping ≥ 3/4 inches in diameter that runs from the hot water source to the kitchen fixtures is insulated.

Faucets & Shower Heads:
All faucets and showerheads installed are certified to the Energy Commission, pursuant to Title 24, Part 6, Section 111.

Central Water Heating in Buildings with Multiple Dwelling Units (required for prescriptive)

✓

☐ All hot water piping in main circulating loop is insulated to requirements of §150(j)

☐ Central hot water systems serving six or fewer dwelling units which have (1) less than 25' of distribution piping outdoors; (2) zero distribution piping underground; (3) no recirculation pump; and (4) insulation on distribution piping that meets the requirements of Section 150(j)

☐ Central hot water systems serving more than 6 dwelling units - presence of either a time control or a time/temperature control

✓ ☐ I, the undersigned, verify that equipment listed above my signature is: 1) the actual equipment installed; 2) equivalent to or more efficient than that specified in the certificate of compliance (Form CF-1R) submitted for compliance with the *Energy Efficiency Standards* for residential buildings; and 3) equipment that meets or exceeds the appropriate requirements for manufactured devices (from the *Appliance Efficiency Regulations* or Part 6), where applicable.

Installing Subcontractor (Co. Name) OR General Contractor (Co. Name) OR Owner	
Signature:	Date:

Copies to: BUILDING DEPARTMENT, HERS RATER (IF APPLICABLE) BUILDING OWNER AT OCCUPANCY

Site Address	Permit Number

INSTALLER COMPLIANCE STATEMENT FOR DUCT LEAKAGE

INSTALLER COMPLIANCE STATEMENT

The building was: ✓ ☐ Tested at Final ✓ ☐ Tested at Rough-in

INSTALLER VISUAL INSPECTION AT FINAL CONSTRUCTION STAGE:

☐ Remove at least one supply and one return register, and verify that the spaces between the register boot and the interior finishing wall are properly sealed.

☐ If the house rough-in duct leakage test was conducted without an air handler installed, inspect the connection points between the air handler and the supply and return plenums to verify that the connection points are properly sealed.

☐ Inspect all joints to ensure that no cloth backed rubber adhesive duct tape is used

☐ New Distribution system is fully ducted (i.e., does not use building cavities as plenums or platforms returns in lieu of ducts).

✓ ☐ **DUCT LEAKAGE REDUCTION**

Procedures for field verification and diagnostic testing of air distribution systems are available in RACM, Appendix RC4.3

NEW CONSTRUCTION:			
	Duct Pressurization Test Results (CFM @ 25 Pa)	Measured Values	
1	Enter Tested Leakage Flow in CFM:		
2	Fan Flow: Calculated (Nominal: ✓ ☐ Cooling ✓ ☐ Heating) or ✓ ☐ Measured If Fan Flow is Calculated as 400 cfm/ton x number of tons or as 21.7 cfm/(kBtu/hr) x Heating Capacity in Thousands of Btu/hr, enter total calculated or measured fan flow in CFM here:		✓ ✓
3	Pass if Leakage Percentage≤ 6% for Final or ≤ 4% at Rough-in: [100 x [_____(Line # 1) / _____(Line # 2)]]		☐ Pass ☐ Fail
ALTERATIONS: Duct System and/or HVAC Equipment Change-Out			
4	Enter Tested Leakage Flow in CFM from **Pre-Test** of Existing Duct System Prior to Duct System Alteration and/or Equipment Change-Out.		
5	Enter Tested Leakage Flow in CFM from **Final Test** of New Duct System or Altered Duct System for Duct System Alteration and/or Equipment Change-Out.		
6	Enter Reduction in Leakage for Altered Duct System [_____(Line # 4) Minus _____(Line # 5)] – (Only if Applicable)		
7	Enter Tested Leakage Flow in CFM to Outside (Only if Applicable)		✓ ✓
8	Entire New Duct System - Pass if Leakage Percentage ≤ 6% for Final [100 x [_____(Line # 5) / _____Line # 2)]]		☐ Pass ☐ Fail
TEST OR VERIFICATION STANDARDS: For Altered Duct System and/or HVAC Equipment Change-Out Use one of the following four Test or Verification Standards for compliance:			✓ ✓
9	Pass if Leakage Percentage ≤ 15% [100 x [_____(Line # 5) / _____ (Line # 2)]]		☐ Pass ☐ Fail
10	Pass if Leakage to Outside Percentage ≤ 10% [100 x [_____(Line # 7) / _____ (Line # 2)]]		☐ Pass ☐ Fail
11	Pass if Leakage Reduction Percentage ≥ 60% [100 x [_____(Line # 6) / _____ (Line # 4)]] and Verification by Smoke Test and Visual Inspection		☐ Pass ☐ Fail
12	Pass if Sealing of all Accessible Leaks and Verification by Smoke Test and Visual Inspection		☐ Pass ☐ Fail
	Pass if One of Lines # 9 through # 12 pass		☐ Pass ☐ Fail

✓ ☐ I, the undersigned, verify that the above diagnostic test results were performed in conformance with the requirements for compliance credit. I, the undersigned, also certify that the newly installed or retrofit Air-Distribution System Ducts, Plenums and Fans comply with Mandatory requirements specified in Section 150 (m) of the 2005 Building Energy Efficiency standards.

Installing Subcontractor (Co. Name) OR General Contractor (Co. Name) OR Owner	
Signature:	Date:

Copies to: BUILDING DEPARTMENT, HERS RATER (IF APPLICABLE) BUILDING OWNER AT OCCUPANCY

SOLAR WATER HEATING CALCULATION FORM (Page 1 of 2) CF-SR

Project Title	Date

CF-SR- Solar Water Heating Calculation Form		**OG-300**
Property Name: _____	Building Type: (Single Family, Multi-family): _____	
Total Conditioned Floor Area (CFA)ft^2: _____	Climate zone (1-16): _____	
INPUTS FOR SYSTEMS SRCC OG-300:		
1. Enter Solar Energy Factor of OG-300 solar water heating system as listed in SRCC directory		
2. Enter Energy Factor of Water Heater (enter .6 for gas .9 for electric)		
3. Constant – 4,1045 (amount of energy used in SRCC test)		41045
4. Constant – 3,500 average parasitic loss value in SRCC test		3500
5. Gallons per day use value calculated as (21.5 * .0014 * CFA)		
6. Constant – 64.3 gallons used in SRCC test method		64.3
7. Hot water supply temperature 135 degrees		135
8. Environmental temperature (Enter value from Table 1 based on entry on Climate Zone)		
9. Difference in supply and inlet water (subtract line 9 from line 8)		
10. Constant - 1500 Solar radiation value used in SRCC test		1500
11. Solar radiation level from Table 1 below		
12. Energy for circulation. (enter 0.9 of forced re-circulation and 1 for all other systems)		
CALCULATION FOR SYSTEM		
13. Multiply line 2 by line 3		
14. Divide line 13 by line 1		
15. Divide line 5 by line 6		
16. Divide the result in line 9 by 77		
17. Subtract 1 by line 2		
18. Multiply lines 14, 15 and 16		
19. Multiply line 4 by line 5 by line 17		
20. Add line 18 to line 19		
21. Divide line 20 by line 3		
22. Divide line 10 by line 11		
23. Multiply line 21 by line 22 and divide by line 12		
24. Subtract 1 by line 23		
Solar Fraction		

Table 1

Climate Zone	Water Temperature	Solar Radiation
1	53.90	1220
2	57.52	1220
3	57.69	1533
4	59.12	1601
5	57.93	1602
6	61.55	1599
7	62.63	1586
8	62.97	1682
9	63.76	1685

Climate Zone	Water Temperature	Solar Radiation
10	63.76	1612
11	61.00	1580
12	59.65	1670
13	63.99	1726
14	61.48	1827
15	73.55	1884
16	50.54	1513

SOLAR WATER HEATING CALCULATION FORM (Page 2 of 2) CF-SR

EXAMPLE

CF-SR- Solar Water Heating Calculation Form **OG-300**

Property Name: _____ Building Type: (Single Family, Multi-family): Single Family

Total Conditioned Floor Area (CFA)ft^2 : 2500 Climate zone (1-16): 2

INPUTS FOR SYSTEMS SRCC OG-300:

1.	Enter Solar Energy Factor of OG-300 solar water heating system as listed in SRCC directory	3.4
2.	Enter Energy Factor of Water Heater (enter .6 for gas .9 for electric)	0.9
3.	Constant - 41045 (amount of energy used in SRCC test)	41045
4.	Constant - 3500 average parasitic loss value in SRCC test	3500
5.	Gallons per day use value calculated as: (21.5*.0014*CFA)	75.25
6.	Constant – 64.3 gallons used in SRCC test method	64.3
7.	Hot water supply temperature 135 degrees	135
8.	Environmental temperature (Enter value from Table 1 based on Climate Zone)	57.52
9.	Difference in supply and inlet water (subtract line 9 from line 8)	77.48
10.	Constant - 1500 Solar radiation value used in SRCC test	1500
11.	Solar radiation level from Table 1below	1220
12.	Energy for circulation. (enter 0.9 of forced re-circulation and 1 for all other systems)	0.9

CALCULATION FOR SYSTEM

13.	Multiply line 2 by line 3	36940.5
14.	Divide by line 13 by line 1	10864.9
15.	Divide line 5 by line 6	1.2
16.	Divide the result in line 9 by 77	1.0
17.	Subtract 1 by line 2	0.1
18.	Multiply lines 14, 15 and 16	12384.8
19.	Multiply line 4 by line 5 by line 17	350.0
20.	Add line 18 to line 19	12734.8
21.	Divide line 20 by line 3	0.3
22.	Divide line 10 by line 11	1.2
23.	Multiply line 21 by line 22 divide by line 12	0.3
24.	Subtract 1 by line 23	0.4
	Solar Fraction	**0.4**